REMARKS/ARGUMENTS

In response to the Office Action mailed February 6, 2006, Applicants amend their application and request reconsideration. In this Amendment claims 13-16, 19, and 20 are cancelled as unnecessary and claim 21 is added so that claims 1-12, 17, 18, and 21 are now pending.

In this Amendment clarifying changes are made in claim 1, explaining more clearly the meaning of the word "across" and adding a missing conjunction. There is no substantive change in claim 1. Claim 4 and the other claims with identical limitations, namely claims 10 and 11, are revised into a format more familiar in U.S. practice. Claim 8 is amended to include the specific article as the first word since that claim is a dependent claim. Unnecessary and potentially confusing words in the claim are eliminated. The dependency of claim 8 is changed for consistency with the disclosure of the patent application and the embodiment described with respect to Figures 12A and 12B which are encompassed by claim 8 and newly added claim 21. Claim 20 is cancelled because, although not noted in the Office Action, it was identical to claim 7. The repetitious claims 13-16 added in eliminating multiple dependencies are voluntarily cancelled.

The Examiner requested a clean form of the Abstract that was presented in amended form in the Preliminary Amendment. That Abstract is supplied here. In addition, upon review of the specification, it appears that some figures may not be mentioned and that the designation of certain figures vary somewhat from the actual designation on the figures themselves. Because a large number of specification amendments would be required to conform those references and to improve the precision with which the drawing figures are described, a substitute specification is supplied. Also supplied is a computer-generated comparison document showing the changes made in preparing the substitute specification. No new matter is added.

The invention is directed to a transverse induction heating apparatus used in manufacturing of iron or steel plates. This kind of apparatus is distinct from a solenoid apparatus as described in the patent application. In a solenoid apparatus, a coil is wound

around the bar or plate that is subjected to heating by the solenoid apparatus. In the transverse apparatus according to the invention, the bar or plate being rolled is heated by inducing current flow within that bar or plate. Current flow is induced by the use of inductors disposed on opposite sides of the plate or bar. Each inductor includes a iron core and a coil wound around the iron core. Moreover, the iron cores are substantially narrower than the width of the plate being rolled and are aligned with the widthwise center line of the plate being rolled.

An important feature of the invention is achieving proper internal temperature in the plate being rolled, particularly a substantially uniform temperature rise in the thickness direction of the plate. The invention considers the current flowing within the plate that is induced by the heating apparatus, and the loss of heat from the plate due to the radiation from the surfaces of the plate. As explained in detail in the patent application, the induced current flows within the plate at a depth that depends upon a number of factors, including the magnetic permeability of the material being rolled and its specific resistance as well as the frequency of the signal applied to the coils of the inductors. The well known equation for calculating the penetration depth of the flowing current appears at the end of claim 1. As explained in the patent application, by choosing the frequency of the AC power the ratio of the thickness of the plate being rolled to the penetration depth of the current is maintained less than 0.95 to achieve the desired uniformity in temperature rise in the thickness direction.

Various of the dependent claims describe important features of the claimed apparatus, such as the interconnection of the respective coils in series. The patent application explains the implications of series and parallel connection of the respective coils. Further, as explained in claims 5, 6, and 8, as well as in claims 12, 71, and 21, the apparatus may include multiple pairs of inductors arranged in line along the rolling direction of the plate, along the plate centerline. As explained in claims 8 and 21, the inductors are driven at different frequencies to provide the important advantages described in the patent application with regard to Figures 12A and 12B at pages 18-20.

All of claims 1-20 were rejected as obvious over Hannoki (JP 10-94818) in view of either Yugawa (JP 58-32383) or King (U.S. Patent 2,477,411). This rejection is respectfully traversed as to all claims now pending.

Hannoki was cited as allegedly describing a transverse induction heating apparatus meeting many of the limitations of claim 1. This comparison is flawed, according to a computer-generated English language translation of Hannoki, obtained from the JPO website, particularly with respect to paragraph [0025] concerning Figures 4a. and 4b of Hannoki. Those schematic side views show some kind of induction heating apparatus for heating a plate or a bar being rolled. The limited disclosure in Hannoki fails to explain whether the inductors and coils, apparently schematically illustrated, have widths that are smaller than the plate width of the material to be rolled and fail to describe whether the inductors are disposed on the widthwise centerline of the material being rolled.

With regard to the pending dependent claims, Hannoki fails to disclose whether the coils of the two inductors shown schematically are connected in series. There is no description in Hannoki of any arrangement for adjusting the positions of inductors in the thickness direction of the material being rolled. There is no arrangement in Hannoki, as in several of the dependent claims, including two pairs of inductors disposed along the traveling direction of the material to be rolled, the use of different frequencies of AC power to drive different pairs of the sequentially arranged inductors, and no description of the surface of any conveying roll being coated with an electrically insulating member. The failure of Hannoki to disclose any of these express limitations of pending dependent claims means that unless the secondary references supply those limitations, then *prima facie* obviousness has not been established with respect to any claim pending.

Yugawa was cited simply for the proposition that it is known to heat steel plates with alternating current power to provide a ratio of thickness of the plate being rolled to current penetration depth of approximately 1. It is apparent by inspecting the figures, particularly Figure 1, of Yugawa that Yugawa does not describe an induction heating apparatus that includes inductors aligned along the center of a plate to be rolled. It appears from that figure and other figures that the inductive heating in Yugawa is intended to improve the uniformity of heating at the edges, i.e., in the width direction, of

the roll of a plate being rolled. Thus, the inductors are located at the edges, not the center of the plate being rolled. In other words, Yugawa fails to supply the arrangement of the inductors along the center of the plate width as in claim 1 and establishment of temperature uniformity in the thickness direction. Further, with respect to the limitations of the dependent claims discussed above, it is apparent that not one of those limitations is anywhere described in Yugawa so that Yugawa cannot, in modifying Hannoki, establish *prima facie* obviousness of independent claim 1, or of essentially all of the dependent claims that are pending as well.

King does not supply any of the claim elements mentioned above and therefore fails to establish *prima facie* obviousness as to any pending claim. Figure 1 of King illustrates a solenoid heating apparatus and is irrelevant to the claimed invention. Figure 2 of King illustrates an induction heating apparatus that heats only one side of a material being rolled. The induction heater lacks an iron core and extends over the full width of the material being rolled. Thus, King fails to describe the arrangement of claim 1, even in combination with Hannoki, in which the inductors are narrower than the plate width and are aligned along the center line of the plate width. In fact, all that King was relied upon for was describing the well known fact, clearly illustrated by Yugawa, that the penetration depth of the current flow is a function of the frequency of the power applied to the inductors.

King likewise fails to describe the various limitations of dependent claims described above. There cannot be any description in King of connecting coils in series because there is only a single coil. There is no arrangement in King for adjusting the position of the coil with regard to the thickness direction of the material being rolled, no arrangement of pairs of inductors along the traveling direction of the material to be rolled, no use of different frequency power sources to drive different pairs of inductors along the rolling direction, nor the coating of any conveying roll with an electrically insulating material.

The Office Action has simply failed to establish *prima facie* obviousness as to any pending claim.

Although non-substantive amendments are made in claim 1, there has been no amendment to that claim nor to any other claim based upon the prior art rejection of the Office Action. Accordingly, any new Office Action cannot properly be a final rejection if that new Office Action relies upon different prior art or a different legal ground for rejecting any pending claim.

Reconsideration and allowance of all remaining claims are earnestly solicited.

Respectfully submitted,

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